

## Features

- Solid-State
- High on-off ratio
- High speed
- Ultra-high reliability
- Low insertion loss
- Compact


## Applications

- Optical blocking
- Configurable operation

Instrumentation

The NanoSpeed ${ }^{T M}$ Series $1 \times 2$ solid-state fiber optic switch connects optical channels by redirecting an incoming optical signal into a selected output optical fiber. This is achieved using patent non-mechanical configurations with solid-state all-crystal designs, which eliminates the need for mechanical movement and organic materials. The device is intrinsic bidirectional and has variable coupler behavior in which light is transferred from one to another port without loss. The NS fiber optic switch is designed to meet the most demanding switching requirements of ultra-high reliability, fast response time, and continuous switching operation. The switch is intrinsically bidirectional and selectable for polarization-independent or polarization-maintain by the fiber type.
The NS Series switch is controlled by 5V TTL signals with a specially designed electronic driver having performance optimized for various repetition rate.
The rise/fall time is intrinsically related to the crystal properties, and the repetition rate is associated with the driver. There are poor frequency response sections due to the device resonances. The NS devices are shipped mounted on a tuned driver.
The NS series switches respond to a control signal with any arbitrary timing with frequency from DC up to MHz. The switch is usually mounted on a tuned driver prior to shipping. The electrical power consumption is related to the repetition rate the switch is operated.
The dual-stage configuration increases the extinction ratio or cross-talk value.

## Specifications

| Parameter |  | Min | Typical | Max | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Central Wavelength ${ }^{[1]}$ |  | 980 |  | 2000 | nm |
| Insertion Loss ${ }^{[2]}$ | 1900 ~ 2100nm |  | 0.9 | 1.5 | dB |
|  | $1260 \sim 1650 \mathrm{~nm}$ |  | 0.6 | 1.0 | dB |
|  | 980~1100nm |  | 0.8 | 1.3 | dB |
| Cross Talk ${ }^{[3]}$ |  | 18 | 25 | 35 | dB |
| Durability |  | $10^{14}$ |  |  | cycles |
| PDL (SMF Switch only) |  |  | 0.15 | 0.3 | dB |
| PMD (SMF Switch only) |  |  | 0.1 | 0.3 | ps |
| ER (PMF Switch only) |  | 18 | 25 |  | dB |
| IL Temperature Dependency |  |  | 0.25 | 0.5 | dB |
| Return Loss |  | 45 | 50 | 60 | dB |
| Response Time (Rise, Fall) |  |  |  | 300 | ns |
| Fiber Type |  | SMF-28, Panda PM, or equivalent |  |  |  |
| Driver Repeat Rate | 100kHz driver | DC | 100 |  | kHz |
|  | 300 kHz driver | DC | 300 |  | kHz |
| Optic Power Handling ${ }^{[4]}$ | Normal power switches |  | 0.3 | 20 | W |
|  | High power switches |  |  | 5 | W |
| Operating Temperature |  | -5 |  | 70 | ${ }^{\circ} \mathrm{C}$ |
| Storage Temperature |  | -40 |  | 85 | ${ }^{\circ} \mathrm{C}$ |

Notes:
[1]. Operation bandwidth is $\pm 25 \mathrm{~nm}$ approximately at 1550 nm .
[2]. Measured without connectors. For other wavelength, please contact us.
[3]. $\pm 25 \mathrm{~nm}$, Cross talk is measured at 100 kHz , which may be degraded at the high repeat rate.
[4]. Defined at $1310 \mathrm{~nm} / 1550 \mathrm{~nm}$. For the shorter wavelength, the handling power may be reduced, please contact us for more information.

> Warning: This is an OEM module designed for system integration. Do not touch the PCB by hand. The electrical static can kill the chips even without a power plug-in. Unpleasant electrical shock may also be felt. For laboratory use, please buy a Turnkey system.

[^0](SMF, PMF, High Power, Bidirectional)

## DATASHEET

Mechanical Dimensions (mm)

Package A for normal power


Package B for high power


Package C for $\lambda=>1.9$ um


Product dimensions may change without notice. This is sometimes required for non-standard specifications.
(SMF, PMF, High Power, Bidirectional)

## DATASHEET <br> Mechanical Dimensions, mounting on 100KHz driver (mm)



Driver with Package A

Driver with Package B

## Driver with Package C


*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

# NanoSpeed ${ }^{\text {TM }} 1 \times 2$ Series <br> Fiber Optical Switch 



300kHz Driver Mechanical Drawing (mm)

## Driver with Package D


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*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

## NanoSpeed ${ }^{\text {TM }} 1 \times 2$ Series <br> Fiber Optical Switch

(SMF, PMF, High Power, Bidirectional)

## DATASHEET

Optical Path Driving Table (Direct driving)

| Optical Path | Pin 1 | Pin 2 |  |
| :---: | :---: | :---: | :---: |
| Port 1 $\rightarrow$ Port 2 | No Power |  |  |
| Port $1 \rightarrow$ Port 3 | H | OV |  |
| H: $360 \sim 420$ V |  |  |  |

* Note: For customers that prefer to design their own driving circuit, they are responsible for the optical performance. For more technical information, please contact us.


## Driving Board Selection

| Maximum Repetition Rate | Part Number (P/N) |
| :---: | :---: |
| 100 kHz for package A | NSSW100ns100kHzD |
| 100 kHz for package B \& C | SWDR-1La261111 |
| 300 kHz for package D | NSSW100ns300kHzD |
| Optical Path | TTL |
| Port $1 \rightarrow$ Port 2 | OV |
| Port $1 \rightarrow$ Port 3 | H |
| H: >=3.5V |  |

## Typical Speed Response Measurement



## Bandwidth Measurement



## DATASHEET

## Ordering Information

|  | 12 | $\square$ | 1 | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ | $\square$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Prefix | Type | Wavelength ${ }^{[4]}$ | Configuration | Package | Fiber Type | Fiber Cover | Fiber Length | Connector ${ }^{[5]}$ | Optical Power |
| $\begin{aligned} & \text { NSSW- }{ }^{[1]} \\ & \text { NHSW- }-{ }^{[2]} \\ & \text { NHHW- }{ }^{[3]} \end{aligned}$ | 1x2 = 12 | $\begin{aligned} & 1060 \mathrm{~nm}=1 \\ & 200 \mathrm{~nm}=2 \\ & 1310 \mathrm{~nm}=3 \\ & 1410 \mathrm{~nm}=4 \\ & 1550 \mathrm{~nm}=5 \\ & 980 \mathrm{~nm}=9 \\ & \text { Special }=0 \end{aligned}$ | Single stage = 1 | ```Standard (Package A) = 1 High power [\mp@subsup{}{}{[6]}}(\mathrm{ Package B) = 3 Package for 2um = C Package D = D Special =0``` | $\begin{aligned} & \text { SMF-28 }=1 \\ & \text { H11060 }=2 \\ & \text { PM1550 }=5 \\ & \text { PM980 }=9 \\ & \text { PM1950 }=\mathrm{L} \\ & \text { Special }=0 \end{aligned}$ | Bare Fiber = 1 900um Tube $=3$ <br> Special = 0 | $\begin{aligned} & 0.25 m=1 \\ & 0.5 m=2 \\ & 1.0 \mathrm{~m}=3 \\ & \text { Special }=0 \end{aligned}$ | $\begin{aligned} & \text { None }=1 \\ & \text { FC/PC }=2 \\ & \text { FC/APC }=3 \\ & \text { SC/PC }=4 \\ & \text { SC/APC }=5 \\ & \text { ST/PC }=6 \\ & \text { LC/PC }=7 \\ & \text { Duplex LC/PC }=8 \\ & \text { LC/APC }=9 \\ & \text { E2000 APC }=A \\ & \text { LC/UP }=U \\ & \text { Special }=0 \end{aligned}$ | $\begin{aligned} & \text { Regular = } 1 \\ & 1 \mathrm{~W}=\mathrm{A} \\ & 2 \mathrm{~W}=\mathrm{B} \\ & 5 \mathrm{~W}=\mathrm{C} \\ & 10 \mathrm{~W}=\mathrm{D} \\ & 20 \mathrm{~W}=\mathrm{E} \end{aligned}$ |

[1]. NSSW - Normal power version
[2]. NHSW - 2 W version
[3]. NHHW - 5W version
[4]. For shorter wavelength, please refer to Premium NS switches. Wavelength $>1900 \mathrm{~nm}$ will be implemented in the special version with long lead time
[5]. Please contact us for high power connectors
[6]. 3-cap package for high power
NOTE:

- PM1550 fiber works well for 1310nm


## Fiber Core Alignment

Note that the minimum attenuation for these devices depends on excellent core-to-core alignment when the connectors are mated. This is crucial for shorter wavelengths with smaller fiber core diameters that can increase the loss of many decibels above the specification if they are not perfectly aligned. Different vendors' connectors may not mate well with each other, especially for angled APC.

## Fiber Cleanliness

Fibers with smaller core diameters $(<5 \mu \mathrm{~m})$ must be kept extremely clean, contamination at fiber-fiber interfaces, combined with the high optical power density, can lead to significant optical damage. This type of damage usually requires re-polishing or replacement of the connector.

## Maximum Optical Input Power

Due to their small fiber core diameters for short wavelength and high photon energies, the damage thresholds for device is substantially reduced than the common 1550 nm fiber. To avoid damage to the exposed fiber end faces and internal components, the optical input power should never exceed 20 mW for wavelengths shorter 650 nm . We produce a special version to increase the how handling by expanding the core side at the fiber ends.

## DATASHEET

## Optical Power Handling vs Wavelength For Single-Mode Fibers



Q \& A

Q: Does NS device drift over time and temperature?
A: NS devices are based on electro-optical crystal materials that can be influenced to a certain range by the environmental variations. The insertion loss of the device is only affected by the thermal expansion induced miss-alignment. For extended temperature operation, we offer special packaging to $-40-100{ }^{\circ} \mathrm{C}$. The extinction or cross-talk value is affected by many EO material characters, including temperature-dependent birefringence, Vp, temperature gradient, optical power, at resonance points (electronic). However, the devices are designed to meet the minimum extinction/cross-talk stated on the spec sheets. It is important to avoid a temperature gradient along the device length.

Q: What is the actual applying voltage on the device?
A: 100 to 400 V depending on the version.
Q: How does the device work?
A: NS devices are not based on Mach-Zander Interference, rather birefringence crystal's nature beam displacement, in which the crystal creates two different paths for beams with different polarization orientations.

Q: What is the limitation for faster operation?
A: NS devices have been tested to have an optical response of about 300 ps . However, practical implementation limits the response speeds. It is possible to achieve a much faster response when operated at partial extinction value. We also offer resonance devices over 20 MHz with low electrical power consumption.

## Operation Manual

1. Connect a control signal to the SMA connector on the PCB.
2. Attach the accompanied power supply (typically a wall-pluggable unit).
3. The device should then function properly.

Note: Do not alter device factory settings.


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